REMARKS

Claims 1-16, 18-25 and 28 are pending in the case. Claims 1-3, 13, 14 and 25 have been amended and new claim 28 has been added. Claims 17, 26 and 27 have been canceled. No new matter has been added to the application.

Claims 1-16 and 18- 24 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Fukunaga, U.S. Patent No. 6,346,940. The Examiner stated essentially that Fukunaga teaches or suggests all the limitations of claims 1 to 24. Applicants respectfully traverse the rejection.

The present invention is directed to a method and system for augmented reality guided instrument positioning. A real view of an environment is displayed. A preferred path for positioning an instrument is determined. The preferred path is marked with a graphics guide. The real view is augmented with a rendering of the graphics guide such that at least one portion of the graphics guide is transparent with respect to other portions of the graphics guide to provide a substantially unobstructed view through the at least one portion of the graphics guide to at least a portion of the instrument. The instrument is aligned to the graphics guide so that the instrument appears in a same location as the graphics guide in the augmented view. When properly aligned, the instrument is visible through the at least one transparent portion of the graphics guide. The instrument is then inserted along the length of the graphics guide. The real instrument and virtual graphics guide appear in the same view for precise spatial alignment.

Fukunaga teaches that a guiding marker preparation unit forms guiding markers (see col. 7, lines 65 to col. 8 line 3). Fukunaga does not teach or suggest "augmenting the real view with a rendering of the graphics guide" as claimed in claims 1 and 13 and 25. Fukunaga teaches an image processing system installed adjoining an electronic endoscope system (see col. 5, lines 30-35). Image processing system views are shown on a display unit while views from the electronic endoscope are shown on a separate monitor (see Figure 3). Fukunaga does not teach or suggest an augmenting the real view with a rendering of the graphics guide, essentially as claimed in claims 1, 13 and 25. Fukunaga only prepares a "map" by inserting guiding markers into a virtual model. Fukunaga does not teach showing a real view that includes the instrument to be positioned (in Fukunaga,

the instrument is an endoscope and captures the real view, thus not being visible itself), and Fukunaga does not teach to overlay the real view with the virtual map for precise spatial alignment (which, of course, cannot be done as the endoscopic instrument is not visible in the real view).

Claims 1, 13 and 25 are believed to be allowable for additional reasons. Fukunaga teaches that a degree of transparency of the virtual endoscopic image Ai is preset, but may be adjusted by an operator (see col. 11, lines 44-49). Fukunaga does not teach or suggest "at least one portion of the graphics guide is transparent with respect to other portions of the graphics guide to provide a substantially unobstructed view through the at least one portion of the graphics guide to at least a portion of the instrument" as claimed in claims 1, 13 and 25. As the Examiner has suggested with respect to claim 3, Fukunaga fails to teach or suggest a transparent guide marker. Fukunaga treats the guiding markers separately from the endoscopic image Ai. Fukunaga teaches that guiding markers are placed <u>on</u> the virtual endoscopic image Ai (see for example, col. 18, line 38 to col. 19, line 60). The transparency of the endoscopic image Ai is set before the guiding markers are placed (see col. 19, lines 30-35). Thus, Fukunaga does not teach or suggest transparent guiding markers. Indeed, Fukunaga fails to teach or suggest that anything other than certain virtual endoscopic images (e.g., images Hi as shown in Figure 15a) may be semitransparent.

In Fukunaga, the guide markers support the user to find the right way along a branching system of "channels" (e.g., bronchial tree). The guide markers are not intended to mark exact spatial endoscope locations inside the channels. In contrast, the present invention uses the virtual graphics guide in the context of an augmented view to precisely mark where a real instrument has to be placed. The user has to perceive the exact spatial relationship between the virtual graphics guide and the real instrument, both visible in the augmented view, and bring the instrument (e.g., needle) into correct alignment with the graphics guide.

Furthermore, Fukunaga fails to teach or disclose "aligning the instrument to the graphics guide so that the instrument appears in a same location as the graphics guide in the augmented view, and when properly aligned, the instrument is visible through the at least one transparent portion of the graphics guide; and inserting the instrument along the

length of the graphics guide". Fukunaga describes a variety of visualization options. To see behind the surface of the virtual model or beyond a graphics guide, Fukunaga renders the guide semi-transparent or as a wireframe.

In contrast, the simple visualization options of Fukunaga are not sufficient to correctly perceive the alignment of a real instrument and a graphics guide in an augmented view. The core problem is that of incorrect occlusion. The virtual guide always occludes the real instrument; correctly when the real instrument is indeed behind the guide, but also incorrectly when the real instrument is actually in front of the virtual guide. Semitransparent rendering of the guide avoids complete occlusion of the real instrument; however, even the partial occlusion of the real instrument by the virtual guide is wrong when the real instrument is in front of the guide, and still interferes with the correct spatial perception.

The present invention introduces the concept of virtual guides. Along the length of the guide, the transparency of the guide is modulated. By this it is meant that there are sections where the guide "disappears" to provide an essentially unobstructed view onto the instrument during the alignment procedure, and other sections where the guide is clearly visible. This modulation introduces a completely new quality to the visualization of the virtual guide, and to the perception of the alignment of the real instrument and virtual guide in the augmented view.

Fukunaga fails to teach or suggest an augmented view as an overlay of a real and a virtual view, a transparent guide marker, modulation of a guide marker's transparency, and alignment of a real instrument and a virtual graphics guide. In light of Fukunaga's deficiencies, one of ordinary skill in the art would not be lead to augmenting the real view with a rendering of the graphics guide having at least one portion of the graphics guide being transparent with which the real instrument is aligned, essentially as claimed in claims 1, 13 and 25. Therefore, Fukunaga fails to teach or suggest all the limitations of claims 1, 13 and 25.

Claims 2-12 and 28 depend from claim 1. Claims 14-16 and 18- 24 depend from claim 13. The dependent claims are believed to be allowable for at least the reasons given for claims 1 and 13. Applicants respectfully request that the rejection of claims 1-16 and 18-24 under 35 U.S.C. 103(a) be withdrawn.

For the forgoing reasons, the present application, including claims 1-16, 18-25 and 28, is believed to be in condition for allowance. The Examiner's early and favorable action is respectfully urged.

Respectfully Submitted,

Date: December 16, 2004

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